The documentation and process conversion measures necessary to comply with this revision shall be completed by 3 March 2014.

INCH-POUND

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3 September 2013
SUPERSEDING
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15 January 2003

DETAIL SPECIFICATION

DISPLAY, OPTOELECTRONIC, SEGMENTED READOUTS, BACKLIGHTED, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for displays, optoelectronic, segmented readouts, backlighted through optical filters.

1.2 Classification. Displays shall be of the following styles and types as specified (see 3.1, 6.2 and 6.4). Displays covered by this specification shall be of the following styles as specified (see 3.1).

a. Style I: Light source, incandescent lamps.

b. Style II: Light source, light emitting diodes.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL–A–8625	–	Anodic Coatings for Aluminum and Aluminum Alloys.
MIL–DTL–28786	–	Switches, Electrical and Fiber Optic, Packaging of.

Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime, ATTN: VAC, P.O. Box 3990, Columbus, OH 43218–3990, or emailed to Semiconductor@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL–DTL–28803/1	–	Display, Optoelectronic, Segmented Readout, Backlighted, Style II (Light Emitting Diode), RFI Shielded, Moisture Sealed, High Impact Shock, Type R01.
MIL–DTL–28803/2	–	Display, Optoelectronic, Segmented Readout, Backlighted, Style I (Incandescent Lamps) RFI Shielded, Moisture Sealed, High Impact Shock, Type R02.
MIL–DTL–28803/3	–	Display, Optoelectronic, Segmented Readout, Backlighted, Style I (Incandescent), Dot Pattern And Bar Pattern, RFI Shielded, Moisture Sealed, Type R03.
MIL–DTL–28803/4	–	Display, Optoelectronic, Segmented Readout, Backlighted, Style I (Incandescent), Dot Pattern And Bar Pattern, Type R04 (Replacement Parts For Type R03 Display Assembly)

FEDERAL STANDARD

FED–STD–H28	–	Screw-Thread Standards For Federal Services.

DEPARTMENT OF DEFENSE STANDARDS

MIL–STD–108	–	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment.
MIL–STD–202	–	Electronic and Electrical Component Parts.
MIL–STD–810	–	Environmental Engineering Considerations And Laboratory Tests.
MIL–STD–889	–	Dissimilar Metals.
MIL–STD–1285	–	Marking of Electrical and Electronic Parts.

(Copies of these documents are available online at http://quicksearch.dla.mil or https://assist.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related associated specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheets, the latter shall govern (see 6.2).

3.1.1 Displays covered by specification sheets and identified by Part or Identifying Number (PIN). Displays which are completely defined by a Department of Defense specification sheet (see 3.1) shall be ordered in accordance with 6.2.1.

3.1.2 Displays covered by specification sheets but not identified by PIN. For displays covered by the specification sheet but not identified by PIN, the type (see 1.2) shall be specified in the complementary document, such as service drawings or ordering data sheets (see 6.2.2). Such displays shall be procured from sources listed on the qualified products list (QPL) for the applicable type.

3.2 Qualification. The displays furnished under this specification shall be products which are authorized by the qualifying activity for listing on applicable QPL at the time of award of contract (see 4.4 and 6.3). The variations allowed from the specification sheet, included in 6.2.2 are as follows and must be within the physical, functional, and environments parameters of the specification sheet:

a. Character.

b. Terminations.

c. Character's colors.

3.3 Material. The material for each part shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the displays to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

3.3.1 Metals. All metal parts, other than current-carrying parts, shall be of corrosion resistant material or shall be suitably protected to resist corrosion.

3.3.1.1 Dissimilar metals and compatible couples. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. The use of dissimilar metals in contact, which tend toward active electrolytic corrosion (particularly brass, copper, or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating or metal spraying of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals and compatible couples are defined in 3.3.1.2.

3.3.1.2 Intermetallic contacts. The finishing of metallic areas to be placed in intimate contact by assembly presents a special problem, since intermetallic contact of dissimilar metals results in electrolytic couples which promote corrosion through galvanic action. To provide the required corrosion protection, intermetallic couples are restricted to those permitted by MIL–STD–889.

3.3.2 Plastic. Unless otherwise specified, thermosetting plastics shall be flame retardant material; however, cellulose filled materials shall not be used. When used, thermoplastics shall be self-extinguishing as applicable to the thinnest section. When used in lenses, material shall be as specified (see 3.1 and 6.2).

3.3.2.1 Fiber sheathing. Plasticized polyvinyl chloride shall not be used as a sheathing material for optical fibers.

3.3.3 Finish. Unless otherwise specified (see 3.1) all external aluminum parts shall be anodized in accordance with MIL–A–8625. The exterior surfaces, designed to be exposed at the front of the panel after assembly, shall have a black lusterless finish.

3.4 Design and construction. The display shall be of the design, construction, temperature range, and physical dimensions as specified (see 3.1).

3.4.1 Mounting hardware. Each display shall be provided with mounting hardware specified (see 3.1 and 6.2). For direct Government orders the hardware shall be assembled in proper order.

3.4.2 Housing. The housing shall be capable of independent or combination mounting as specified (see 3.1).

3.4.3 Screw threads. Screw threads on external threaded parts or parts subjected to replacement or removal, shall be in accordance with FED–STD–H28.

3.4.4 Termination. Termination shall be as specified (see 3.1).

3.4.4.1 Plug-in units. The plug-in units shall be positive keyed to achieve proper alignment of legend in relation to fixed assembly when removed (see 3.1).

3.4.5 Weight. The weight shall be as specified (see 3.1 and 6.2).

3.4.6 Light source. The light source shall be as specified (see 1.2, 3.1, and 6.2).

3.4.6.1 Light source circuitry. The light source circuits shall be isolated electrically from the display assembly case and its mounting means.

3.4.6.2 Light source replacement. Light source replacement shall be as specified (see 3.1 and 6.2).

3.4.6.3 Light source contacts. Light source contacts shall be of suitable material or plated to resist electrolytic corrosion of the contact or the light source base.

3.4.7 Lens. The lens shall be free from defects which will prevent it from meeting luminous distribution and color requirements. Unless otherwise specified, there shall be no highlight reflective surfaces on the displays.

3.4.8 Color filters. Material for lamp color filters (used to convert clear incandescent lamps to colored lighting) shall be silicone rubber, unless otherwise specified (see 3.1).

3.4.9 Panel seals. Material for panel seals shall be silicone rubber.

3.5 Performance. The displays shall be capable of meeting the tests specified in 4.6, and the specification sheets, as applicable. Lamp failure shall not be considered a unit failure when the lamp failure is noted immediately and a new lamp is installed and functions, then the test shall be continued, as required. However, a light source failure for a non-replaceable item (see 3.1) shall be considered a unit failure.

3.5.1 Visual and mechanical examination. When inspected as specified in 4.6.1, the displays, associated modules and component parts shall conform to the acceptance requirements specified in 3.1, 3.3 (material), 3.4 (design and construction), 3.6 (marking), and 3.8 (workmanship), inclusive.

3.5.2 Operating characteristics. When displays are tested as specified in 4.6.2, the operating characteristics shall be as specified (see 3.1 and 6.2).

3.5.2.1 Character distortion. When displays are tested as specified in 4.6.2.1, the displayed character(s) shall appear clear and legible.

3.5.2.2 Dot-to-dot ratio. When tested as specified in 4.6.2.2 the dot-to-dot ratio shall be as specified (see 3.1).

3.5.3 Optical characteristics. When displays are tested as specified in 4.6.3, the operating characteristics shall be as specified (see 3.1 and 6.2).

3.5.3.1 Chromaticity. When displays are tested as specified in 4.6.3.1 the requirements shall be as specified in table I.

3.5.3.2 Contrast ratio. When displays are tested as specified in 4.6.3.2 the contrast ratio shall be as specified (see 3.1).

3.5.3.3 Field of view. When displays are tested as specified in 4.6.3.3 the visibility of the display shall not be restricted by the periphery of the enclosure for the display.

3.5.3.4 Luminance. When displays are tested as specified in 4.6.3.4 the measured photometric brightness in the visible spectrum shall be 10-foot lamberts minimum at rated voltage (see 3.1).

TABLE I. Illuminated chromaticity limits. 1/

Color	@2100° Kelvin	
	X	Y
Red	.695 .703 .655 .660	.285 SL 2/ .325 SL 2/
Green	.260 .300 .160 .200	.570 .630 .660 .720
Yellow	.562 .570 .596 .605	.415 SL 2/ .382 SL 2/
White	.400 .460 .400 .460	.420 .420 .380 .380
Amber	.596 .607 .625 .636	.380 SL 2/ .351 SL 2/

1/ The chromaticities of the color character expressed as X and Y coordinates on the CIE chromaticity diagram shall be within areas bounded by the coordinates listed for each color, using a source illuminate of Kelvin value as stated.
2/ SL = Spectrum locus (where intersected by other coordinate pair).

3.5.4 Physical and mechanical characteristics.

3.5.4.1 Mechanical endurance (applicable to plug-in units only). When displays are tested as specified in 4.6.4.1 there shall be no breakage of parts or degradation of performance. The removable plug-in unit shall remain capable of removal by normal external pressure.

3.5.4.2 Resistance to soldering heat (when specified (see 3.1 and 6.2). When displays are tested as specified in 4.6.4.2 here shall be no evidence of electrical or mechanical damage.

3.5.4.3 Solderability (applicable to solderable terminals). When displays are tested as specified in 4.6.4.3 terminals shall be at least 95 percent covered with a new smooth shiny solder coating. The remaining 5 percent of the terminal surface may show only small pinholes or rough spots. These shall not be concentrated in one area. Bare base metal and areas where the solder dip failed to cover the original coating are indications of poor solder ability.

3.5.4.4 Terminal strength. When displays are tested as specified in 4.6.4.4 there shall be no movement or loosening of parts, or other mechanical damage.

3.5.5 Electrical characteristics.

3.5.5.1 Dielectric withstanding voltage (DWV). When displays are tested as specified in 4.6.5.1 there shall be no flashover, arcing, breakdown or current flow in excess of 100 microamperes.

3.5.5.2 Life (electrical). Upon completion of tests specified in 4.6.5.2 displays shall meet the dot-to-dot ratio and luminance requirements of 3.5.2.2 and 3.5.3.4, respectively.

3.5.5.3 Overload. When displays are tested as specified in 4.6.5.3 there shall be no evidence of electrical or mechanical damage.

3.5.6 Environmental characteristics.

3.5.6.1 Moisture resistance. When displays are tested as specified in 4.6.6.1, there shall be no evidence of excessive corrosion, breaking, cracking, or other defects detrimental to the intended function of the display. When displays are tested in the wet condition, the insulation resistance shall not be less than 10 megohms. At the end of the drying period, the insulation resistance shall not be less than 1,000 megohms. Excessive corrosion is defined as that which interferes with the electrical or mechanical performance and has penetrated the plating and has attacked the base material.

3.5.6.2 Salt spray (corrosion). When displays are tested as specified in 4.6.6.2 there shall be no evidence of excessive corrosion that interferes with the electrical or mechanical performance, penetrates the plating, and attacks the base material. There shall be no warping, cracking or other damage to the displays.

3.5.6.3 Seal (when applicable).

3.5.6.3.1 Dripproof (45 degrees). When displays are tested as specified in 4.6.6.3.1 there shall be no leakage of water through the panel seal as determined by visual examination. Following the test, displays shall meet the dielectric withstanding voltage requirements of 3.5.5.1.

3.5.6.3.2 Immersion. When displays are tested as specified in 4.6.6.3.2 there shall be no leakage of water into the display as determined by visual examination. Following the test, displays shall meet the dielectric withstanding voltage requirements of 3.5.5.1.

3.5.6.4 Shock.

3.5.6.4.1 Method I. When displays are tested as specified in 4.6.6.4.1, there shall be no broken, loose, deformed or displaced parts at the conclusion of the test.

3.5.6.4.2 Method II (when specified). When displays are tested as specified in 4.6.6.4.2, there shall be no displaced parts and the readout shall be electrically and mechanically operable at the conclusion of the test.

3.5.6.5 Thermal shock. When displays are tested as specified in 4.6.6.5, there shall be no mechanical or electrical damage or loosening of fastening devices. There shall be no discoloration or deformation of the lens.

3.5.6.6 Vibration. When displays are tested as specified in 4.6.6.6, there shall be no chipping or cracking of materials, or loosening, bending, warping or distortion of parts.

3.6 Marking.

3.6.1 Product identification. Displays shall be marked in accordance with MIL–STD–1285 with the following information:

a. PIN (see 6.4) or type with manufacturer's part number as applicable.

b. Display manufacturer's name, trademark or code symbol, and date code.

c. When 3.6.1.a is not applicable, the manufacturer's part number, the Government drawing number, or prime contractor's number shall be marked on the unit package.

3.6.2 Terminal identification (see 3.1 and 6.2). Terminals shall be marked to indicate the contact arrangement of the display. When specified (see 3.1 and 6.2) terminal markings shall be augmented by a circuit schematic. There shall be no over-marking of the terminal identification.

3.7 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.8 Workmanship. Displays shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts, sharp edges, burrs, and other defects which will affect life, serviceability or appearance.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.4).

b. Conformance inspection (see 4.5).

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspections shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment (i.e., industry standard, Department of Defense standard) shall be required.

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL–STD–202.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3), on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. The specified number of displays for which qualification is sought shall be submitted for qualification inspection. The sample submitted shall consist of displays as specified in the applicable specification sheet, and in the quantity specified (see 3.1).

4.4.2 Inspection routine. Sample units of displays shall be subjected to the qualification inspection specified in table II in the order shown. All sample units shall be subjected to the inspection of group I. The sample units shall then be divided as specified in table II and subjected to the inspection for their particular group.

TABLE II. Qualification and group B inspection.

Examination or test	Requirement	Method
Group I (all sample units)		
Visual and mechanical examination 1/	3.5.1	4.6.1
Operating characteristics	3.5.2	4.6.2
Character distortion	3.5.2.1	4.6.2.1
Group II (4 sample units)		
Thermal shock	3.5.6.5	4.6.6.5
Vibration	3.5.6.6	4.6.6.6
Shock	3.5.6.4	4.6.6.4
Moisture resistance	3.5.6.1	4.6.6.1
Dielectric withstanding voltage	3.5.5.1	4.6.5.1
Operating characteristics	3.5.2	4.6.2
Character distortion	3.5.2.1	4.6.2.1
Seal (when applicable)	3.5.6.3	4.6.6.3
Group III (2 sample units)		
Terminal strength	3.5.4.4	4.6.4.4
Solderability (when applicable)	3.5.4.3	4.6.4.3
Resistance to soldering heat (when specified)	3.5.4.2	4.6.4.2
Salt spray (corrosion)	3.5.6.2	4.6.6.2
Group IV (12 sample units) (2 for each color)		
Chromaticity	3.5.3.1	4.6.3.1
Overload	3.5.5.3	4.6.5.3
Life (electrical)	3.5.5.2	4.6.5.2
Luminance	3.5.3.4	4.6.3.4
Dot-to-dot ratio	3.5.2.2	4.6.2.2
Contrast ratio	3.5.3.2	4.6.3.2
Field of view	3.5.3.3	4.6.3.3
Character distortion	3.5.2.1	4.6.2.1
Group V (2 sample units)		
Mechanical endurance (when applicable)	3.5.4.1	4.6.4.1

1/ Two sample units only for dimensions.

4.4.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.4.4 Extent of qualification.

4.4.4.1 Single submission. Qualification shall be restricted to the type submitted.

4.4.4.2 Group submission. The extent of qualification shall be in accordance with the applicable specification sheet (see 3.1).

4.4.5 Retention of qualification. To retain qualification, the supplier shall forward a report at 36-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

a. A summary of the results of the tests performed for inspection of product for delivery, group A indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

b. The results of tests performed for qualification verification inspection, group B, including the number and mode of failures. If the test results indicate nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action shall be taken to remove the failing product from the QPL.

Failure to submit the report within 30 days after the end of each 36-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time that the inspection data indicates noncompliance of the product to meet the requirements of this specification.

4.5 Conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group inspection except as specified in 4.5.2.1.3. Delivery of products which have passed the group A inspection shall not be delayed pending the results of the group B inspection.

4.5.1.1 Inspection lot. An inspection lot shall consist of all displays of the same specification sheet of the same enclosure design, temperature characteristic, vibration grade, shock type, and design and construction, produced under essentially the same conditions, and offered for inspection at one time. Similar displays conforming to these requirements but having different circuitry may be combined to form a lot.

4.5.1.2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table III in the order shown.

4.5.1.2.1 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE III. Group A inspection.

Examination or test	Requirement	Method	Sample plan	
			Major	Minor
Visual and mechanical examination	3.5.1	4.6.1	n = 45, c = 0	n = 22, c = 0
Operating characteristics	3.5.2	4.6.2	n = 45, c = 0	
Character distortion	3.5.2.1	4.6.2.1	n = 45, c = 0	

4.5.2 Qualification verification inspection. Qualification verification inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.2.1.3), delivery of products which have passed group A shall not be delayed pending the results of these qualification verification inspections.

4.5.2.1 Group B inspection. Group B inspection shall be completed in accordance with table II within 3 years after initial qualification and within each 3-year period thereafter. A manufacturer's normal quality control tests, production control tests, production tests, and environmental tests may be used to fulfill all or part of group B inspection; however, all of group B inspection shall be completed as specified.

4.5.2.1.1 Failures. If one or more sample units fail group B inspection, the sample shall be considered to have failed.

4.5.2.1.2 Disposition of sample units. Sample units subjected to group B inspection shall not be delivered on a contract or order; however, they shall be forwarded to the qualifying activity.

4.5.2.1.3 Noncompliance. If a sample fails group B inspection, the supplier shall take corrective action on those materials and/or processes, as necessary, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstituted however, final acceptance shall be withheld until the group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3 Inspection of packaging. Sample packages and packs and the inspection of the preservation-packaging, packing, and marking for shipment and storage shall be in accordance with MIL–DTL–28786.

4.6 Methods of examination and test.

4.6.1 Visual and mechanical examination. The visual and mechanical features of the displays, associated modules and component parts shall be inspected using suitable optical aids and mechanical measurement gages (i.e., calipers, micrometers, pin gages, templates, etc.) capable of sufficient accuracy, precision and resolution to accomplish the necessary measurements. Only two of the sample units shall be inspected for compliance to physical dimensions.

4.6.1.1 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials used in fabricating the displays are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

4.6.2 Operating characteristics (see 3.5.2). Displays shall be measured for operating characteristics in accordance with the applicable requirements (see 3.1 and 6.2).

4.6.2.1 Character distortion (see 3.5.2.1). The lighted character(s) shall be visually examined for uniformity of character brightness, legibility, and clearness of display. The light character(s) shall be visually examined while being viewed at a distance of 18 inches (457 mm) in a plane normal to the lens face to determine distortion (see 3.1).

4.6.2.2 Dot-to-dot ratio (see 3.5.2.2). Using the luminance values recorded during the luminance test (see 4.6.16), the dot-to-dot ratio (D) shall be determined by using the highest recorded point reading and the lowest recorded point reading and calculation:

$$D = \frac{\text{highest recorded point reading}}{\text{lowest recorded point reading}}$$

4.6.3 Optical characteristic tests.

4.6.3.1 Chromaticity (see 3.5.3.1). The chromaticity shall be determined by spectrographic means as specified (see 3.1 and 6.2) as follows:

a. Method I. Spectrophotometer – flat slab: Chromaticity shall be determined using a spectrophotometer, flat slab material of the same density and thickness of the shaped filter, and necessary calibration filters.

b. Method II. Spectroradiometric: Chromaticity shall be determined using a spectroradiometer, a complete illuminated display assembly, calibrated lamps of specified color temperature, and necessary calibration filters.

c. Method III. Visual comparator: Chromaticity shall be determined by a color comparator, necessary high and low limit plastic or glass filters of known chromaticity, and calibrated light sources of specific color temperature.

4.6.3.2 Contrast ratio (see 3.5.3.2). Displays shall be tested, when specified, in accordance with 4.6.3.2.1 and 4.6.3.2.2. A light source with a color temperature between 3,000 and 5,000 degrees Kelvin shall be directed from an angle of 45 degrees ±2 degrees to the normal of a diffuse white reflectance standard (pressed from barium sulfate or Polytetrafluoroethylene resin powder). The size of the of the light source shall be limited to a conical full angle ≤ 20 degrees as measured from the center of the reflectance standard. The photometer shall be placed at 90 degrees to and focused on the center of the reflectance standard. The light source shall be adjusted to produce a reading of 6,568 foot-lamberts (22503 candela per square meter) (equivalent to an incident illumination of 9,290 foot-candles). The reflectance standard shall be removed and replaced with the display to be tested. The viewing surface of the display shall be placed in the same plane as at the reflectance standard and moved as required to make the specified measurements. The relative positions of the light source and the photometer shall not be changed during these tests.

4.6.3.2.1 Contrast ratio with all segments illuminated. At least two readings shall be taken at equidistant points on each illuminated segment. The readings shall be averaged. At least two readings shall then be taken at equidistant points in the background immediately next to each illuminated segment. The background readings shall also be averaged. The contrast ratio shall be determined by measuring B1 (average brightness of background) and B2 (average brightness of segment) and calculating:

$$C = \frac{B2 - B1}{B1}$$

4.6.3.2.2 Contrast ratio with alternate segments illuminated. The odd numbered segments shall be fully illuminated and the even numbered segments shall be non-illuminated. At least two readings shall be taken at equidistant points on each segment. The luminance readings of illuminated segments shall be averaged, and the readings of the non-illuminated segments shall be averaged.

The contrast ratio shall be determined by measuring B2 (brightness of illuminated segment) and B3 (brightness of non-illuminated segment) and calculating:

$$C = \frac{B2 - B3}{B3}$$

4.6.3.3 Field of view (see 3.5.3.3). The displays shall be mounted in a horizontal position with the character(s) lighted. The lens face shall be viewed from a distance of 3 feet (0.91 m), unless otherwise specified (see 3.1), all angles up to 45 degrees to a line perpendicular to the viewing surface.

4.6.3.4 Luminance (see 3.5.3.4). All luminance measurements shall be taken in completely dark surroundings and all segments shall be illuminated. All readings shall be point readings and averaged. Luminance readings shall be taken by a calibrated photoelectric photometer. The spot size used shall be no smaller than 50 percent or no larger than 80 percent of the segment dot size or line width. With the photometer element fully illuminated, at least two readings shall be taken at equidistant points along each illuminated segment of the character.

4.6.4 Physical and mechanical tests.

4.6.4.1 Mechanical endurance (see 3.5.4.1) (applicable if cable to plug – in units only). Displays shall be subjected to 150 insertions and removals, either manually or automatically.

4.6.4.2 Resistance to soldering heat (when specified, see 3.5.4.2)(see 3.1 and 6.2). Displays shall be tested in accordance with method 210 of MIL–STD–202, test condition B.

4.6.4.3 Solderability (see 3.5.4.3) (applicable to solderable terminals). Solder type terminations shall be tested in accordance with method 208 of MIL–STD–202. The following details and exceptions shall apply:

a. Number of terminations to be tested: Two terminals per unit.

b. Examination of termination: Terminals shall be examined for solder coating, pinholes or rough spots, or whether concentrated in one area.

4.6.4.4 Terminal strength (see 3.5.4.4). Displays shall be mounted by their normal mounting means. No terminals shall be tested in more than one direction. Terminals shall be tested in accordance with method 211 of MIL–STD–202. The following details and exceptions shall apply:

a. Test condition: As specified (see 3.1).

b. Applied force: As specified (see 3.1).

c. Following the test, displays shall be examined for movement or loosening of parts, visible permanent set or evidence of mechanical damage.

4.6.5 Electrical tests.

4.6.5.1 Dielectric withstanding voltage (see 3.5.5.1). Displays shall be tested in accordance with method 301 of MIL–STD–202, at atmospheric pressure. The following details and exceptions shall apply:

a. Test voltage: One thousand volts root-mean-square (rms).

b. Duration of application: One minute for qualification and group B tests; 5 seconds for other tests.

c. Points of application: Between all terminals and housing.

4.6.5.2 Life (electrical) (see 3.5.5.2). Displays shall be subjected to 300 hours of continuous operations with the light source of the highest wattage energized at its maximum voltage. The following test procedures shall apply:

a. Twelve display units shall be mounted on a vertical aluminum panel, matrixed in three horizontal rows of four readouts per row.

b. Tests shall be conducted at the maximum operating temperature specified.

c. At the completion of the test, the readouts shall be tested in accordance with the dot-to-dot ratio and luminance tests of 4.6.2.2 and 4.6.3.4, respectively.

4.6.5.3 Overload (see 3.5.5.3). With all segments illuminated, displays shall be subjected to 140 percent of rated voltage at the power supply for 10 milliseconds minimum. Displays shall then be examined for evidence of damage.

4.6.6 Environmental tests.

4.6.6.1 Moisture resistance (see 3.5.6.1). Displays shall be tested in accordance with method 106 of MIL–STD–202. The following details and exceptions shall apply:

a. Mounting: By normal mounting means on a corrosion-resistant metal panel extending beyond the display device, positioned 15 degrees from the vertical and uninsulated.

b. Polarization: During steps 1 to 6 inclusive, a polarizing voltage of 100 volts direct current (dc) shall be applied between all terminals tied together and the metal panel. Steps 7a and 7b are not applicable.

c. Load voltage: Not applicable.

d. Final measurement: Insulation resistance. Within 5 minutes after conclusion of the test and while the displays are still wet, insulation resistance shall be measured in accordance with method 302 of MIL–STD–202, test condition B. Points of measurements shall be between each terminal and housing.

4.6.6.2 Salt spray (corrosion) (see 3.5.6.2). Displays shall be tested in accordance with method 101 of MIL–STD–202 with associated mounting and terminal hardware assembled. The following details and exceptions shall apply:

a. Test condition B.

b. Measurements after exposure: Displays shall be examined for evidence of excessive corrosion, warping, cracking, or other damage.

4.6.6.3 Seal (when applicable) (see 3.1, 3.5.6.3 and 6.2).

4.6.6.3.1 Dripproof (45 degrees). With the display mounted by its normal mounting means, the readout shall be subjected to the dripproof test of MIL–STD–108 with a 5 gallon (18.9 l) quantity of water flowing over the specimen for 5 minutes duration. The water shall be directed within 12 inches (30.5 cm) above the test specimen. Following the test, the dielectric withstanding voltage shall be measured as specified in 4.6.5.1.

4.6.6.3.2 Immersion. With the display mounted by its normal mounting means, the readout shall be subjected to procedure I of test method 512 of MIL–STD–810. Following the test, the dielectric withstanding voltage shall be measured as specified in 4.6.5.1.

4.6.6.3.2.1 Alternate test. Upon receiving approval by the qualifying activity, test condition A of method 104 of MIL–STD–202 may be used in lieu of testing protocol of MIL–STD–810.

4.6.6.4 Shock (see 3.5.6.4). Displays shall be tested as specified in 4.6.6.4.1, method I, and in addition, when specified (see 3.1), displays shall also be tested as specified in 4.6.6.4.2, method II. The following details and exceptions shall apply:

4.6.6.4.1 Method I. Displays shall be tested in accordance with method 213 of MIL–STD–202. The following details shall apply:

a. Mounting means: Displays shall be mounted on a rigid metal panel by their normal mounting means.

b. Test condition A.

c. Measurement after test: Displays shall be examined for evidence of broken, deformed or displaced parts.

4.6.6.4.2 Method II. Displays shall be tested in accordance with method 207 of MIL–STD–202. The following details shall apply:

a. Mounting means: Displays shall be mounted on the standard mounting fixture detailed in method 207 of MIL–STD–202.

b. Measurement after test: Display shall be electrically operable.

4.6.6.5 Thermal shock (see 3.5.6.5). Displays shall be tested in accordance with method 107 of MIL–STD–202. The following details shall apply:

a. Test condition A.

b. Measurements before and after cycling: Not applicable.

c. Examinations after test displays shall be examined for mechanical and electrical damage and loosening of fastening devices and discoloration or damage to lenses.

4.6.6.6 Vibration (see 3.5.6.6). Displays shall be tested in accordance with MIL–STD–202. The following details and exceptions shall apply:

a. Test condition:

(1) For vibration grade 1: Method 201 (10-55 Hz).

(2) For vibration grade 2: Method 204, test condition A (10-500 Hz).

(3) For vibration grade 3: Method 204, test condition B (10-2000 Hz).

b. Tests and measurements prior to vibration: Not applicable.

c. Mounting displays shall be rigidly mounted by their normal mounting means on a rigid metal panel. The mounting fixture shall be free from resonances over the test frequency range. Displays that are designed to mate with connectors shall be tested using the complete connector assembly.

d. During the test, the display shall be monitored for circuit discontinuities by measuring the electrical continuity of the circuit. All display segments shall be illuminated at rated voltage. A circuit discontinuity shall be defined as a voltage discontinuity of 20 milliseconds or greater.

e. Test and measurements after vibration: Displays shall be examined for evidence of broken, deformed, displaced or loose parts.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The optoelectronic displays covered by this specification are intended for use as panel displays.

6.2 Acquisition requirements.

6.2.1 Display types covered by specification sheets and identified by military part number. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Title, number, and date of the applicable specification sheet and the complete part number (see 3.1).

c. Packaging requirements (see 5.1).

6.2.2 Display types covered by specification sheets and identified by manufacturer's type designation. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Title, number, and date of the applicable specification sheet.

c. Type of qualified display.

d. Manufacturer's part number of modified display and associated drawing detailing the modified display.

e. Details of the variations from the specification sheet (see note below).

f. If mounting hardware is not to be assembled (see 3.4.1).

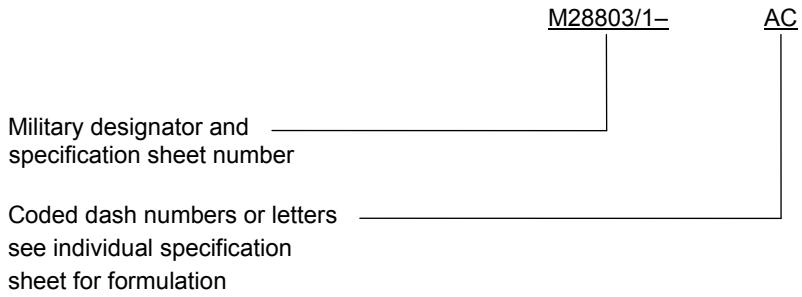
g. Lamp, if required (see 3.4.6).

h. Packaging requirements (see 5.1).

NOTE: A copy of the drawing furnished under (6.2.2.e) including the description of the variations from the specification sheet, should be sent to the preparing activity as listed in the individual specification sheet.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List (QPL–28803) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQH, P.O. Box 3990, Columbus, OH 43218-3990 or e-mail vqh.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.4 Part or Identifying Number (PIN). The PIN for displays specified herein (see 3.1) are created in the following format:



6.5 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmentally Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at http://www.epa.gov. Included in the list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements specified herein (see 4).

6.6 Subject term (key word) listing.

Character
Chromaticity
Light source
Polytetrafluoroethylene resin (PTFE)
Termination

6.7 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army – CR
Navy – EC
Air Force – 85
DLA – CC

Preparing activity:
DLA – CC

(Project: 5980–2013–005)

Review activities:
Army – AR, AT, AV, CR4, MI
Navy – AS, MC, OS, SH
Air Force – 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.